

SHARP

LCD Technologies

July 2008

Advanced LCD Technology



In pursuit of the greater possibilities of LCD technology

In order to meet the more diversified demands for displays, Sharp is not stopping at improving visual quality, but is challenging the boundaries of integrating displays into advanced systems and giving them more advanced functions. We shall continue to pursue the possibilities of LCD technology by combining the technology that we have accumulated over the years.



Liquid Crystal Triangle — The Pride of Sharp Technology

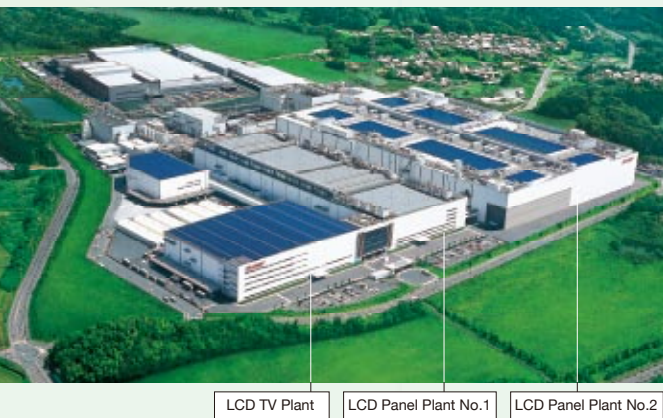
The plants at Kameyama, Nara, Tenri, Sakai and Mie are all situated in neighboring regions, facilitating the active exchange of information among engineers.

Development of a "Manufacturing Complex for the 21st Century" in Sakai

In continuing its efforts to become an "environmentally advanced company," Sharp has been developing its business on the two pillars of energy-saving "LCDs" and energy-creating "solar cells." In order to further these efforts, Sharp is building a new factory complex in Sakai, Osaka prefecture. We hope to further propel our business forward by having companies in related fields with advanced technology join us to create a "Manufacturing Complex for the 21st Century."



A "Super Green Factory" that Incorporates the Latest Environmental Technology



The cutting-edge Kameyama Plant combines advanced LCD technology and television production technology, and is also setting the pace in environmental responsibility. A co-generation system and solar power generation system combine to provide one-third of the annual power usage. Together with the utilization of waste heat, we are reducing CO₂ emissions by about 40 percent*. In addition, we have introduced advanced environmental technology that allows us to recycle one hundred percent of the water used in the manufacturing process.

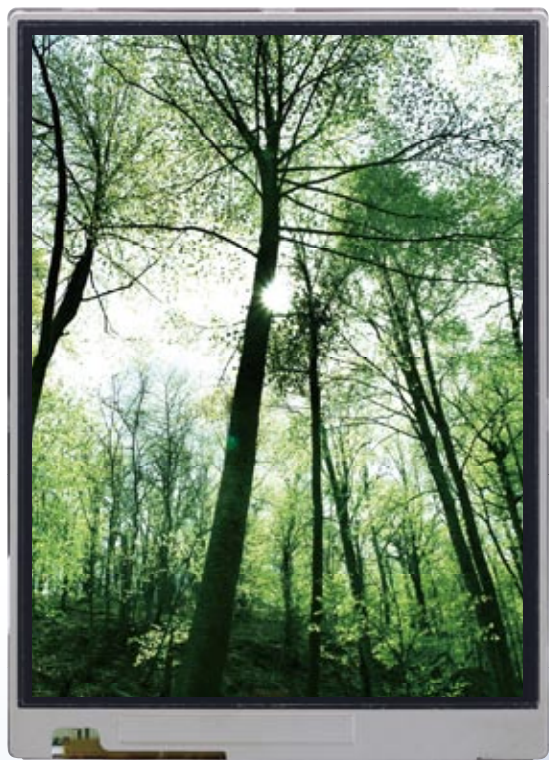


* Compared with generating the same amount of power at a fossil fuel power plant, according to our estimates.

New Mobile Advanced Super V

Liquid Crystal Display

Nearly LCD TV display quality – an advanced form of Super Mobile LCD



Just when it becomes really feasible to watch movies on your mobile equipment, here is the New Mobile Advanced Super V LCD. Precision alignment of the liquid crystal molecules gives a wide viewing angle of 176° from all directions. This, coupled with a superb contrast ratio of 2 000:1 and super-fast responsiveness (black ↔ white in 8 ms), gives unsurpassed video display quality.

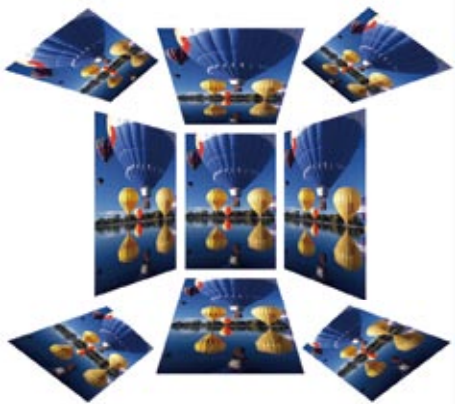
Clear, wide viewing angles from any direction

The New Mobile Advanced Super V LCD provides a wide viewing angle of 176° from all directions, making it ideally suited to the many different scenarios in which mobile equipment is used.

Conventional product



New Mobile Advanced Super V LCD



High contrast for brilliantly vivid color reproduction

The 2 000:1 contrast ratio provides startlingly vivid video images when compared with conventional mobile equipment.

Conventional product



New Mobile Advanced Super V LCD



Crystal-clear images with almost no afterimages, even with fast movement

With lightning-fast display response times of only 8 ms (black ↔ white), the New Mobile Advanced Super V LCD gives clear, sharp images with almost no afterimages, even in videos of fast-moving subjects.

Conventional product



New Mobile Advanced Super V LCD



Applications

Allows unprecedented freedom in the way we use mobile equipment.



TV viewing

Terrestrial digital broadcasts that everyone can watch. The wide viewing angle means that everyone sees a clear, bright image.



Video photography

Great for all kinds of shooting styles – high-angle, low-angle, whatever.



Mobile phones



PDA's



Digital cameras



Video cameras



Portable music players

LCDs with Embedded Optical Sensors

Liquid Crystal Display

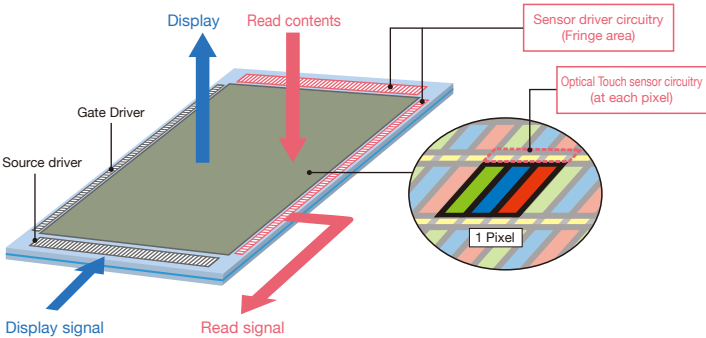
Built-in touch screen functions – LCDs evolving into input/output devices



Touch screen functionality is built into LCDs while maintaining their original high definition images. These LCDs are capable of processing complicated operations, such as simultaneous input from multiple points, and there are high expectations for these LCDs as thin input/output devices.

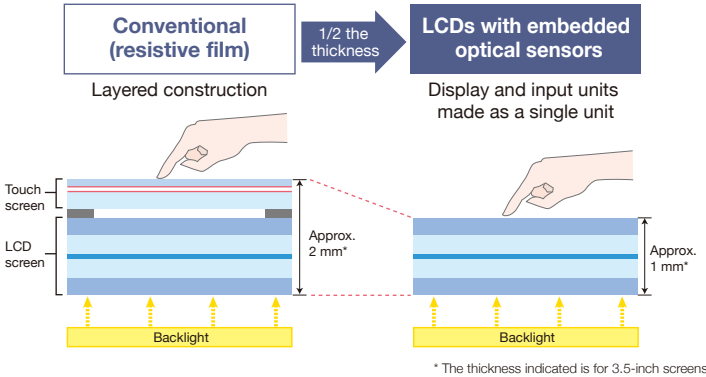
Evolving from display (output) devices into input/output devices

Each LCD panel pixel has an optical sensor using a photodiode. The various signals that are output according to the intensity of the input light can be read from outside the display.



Thinner devices with the high definition of LCDs

By combining touch screens and LCDs, we have achieved thinner devices that have the high definition of LCDs.



Simultaneous recognition of multiple points

Operation and simultaneous input using two or more fingers are possible. Such complicated operations allow a wider range of uses.

Examples of operation using multiple fingers

Map screen operation

Maps can be handled (zoom in/out, rotated) with two fingers.

Zoom in

Zoom out

Rotate

Music screen operation

Three or more points can be pressed at the same time.

Simultaneous input of keys to output a chord.

Various input devices are recognized

Any type of input device can be used for operation; e.g., fingers, fingernails, gloved fingers, pens, etc.



Applications

Highly precise touch screens that can be used for more intuitive interfaces.

Video cameras

Digital cameras

Mobile phones

PDA Smart phones

Portable music players

Advanced Super V

Liquid Crystal Display

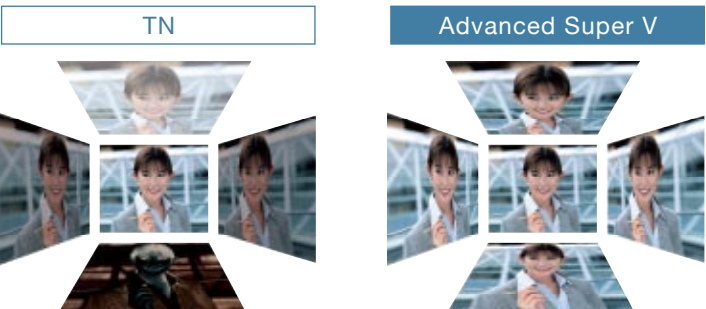
A truly advanced LCD with a wide viewing angle, fast response times and excellent contrast.



The Advanced Super V LCD is a high-end LCD panel employing advanced technology developed exclusively by Sharp. For LCD TV screens, the liquid crystal molecules in the LCD are specially aligned to give a wide viewing angle of 176° from all directions. This has been combined with low-reflectance black TFT liquid crystal and the "normally black" system to achieve deep, rich blacks and a TV screen with a superb contrast ratio of 2 000:1 or better.

Wide viewing angle for bright, clear images from any direction

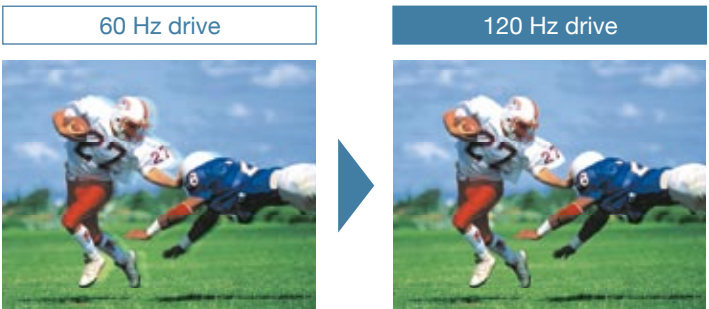
The Advanced Super V LCD delivers a wide viewing angle of 176° from the top, bottom, left, and right, which makes it ideal for all sorts of applications and usage configurations. There is very little color shift with viewing angle changes and no gray scale inversion, so the picture looks bright and sharp from any direction.



Conceptual illustration of viewing angle characteristics

Clear picture with reduced afterimages during rapid-motion video

Responsiveness has been boosted by increasing the response rate of the liquid crystal molecules and the use of high-speed driver technology. The result is a clear picture with markedly reduced afterimages when reproducing rapid-motion image.



Conventional LCD (LCD TV)

Newly developed LCD (LCD TV)

Applications Provides superb video quality in all screen formats, from small through to medium and large.



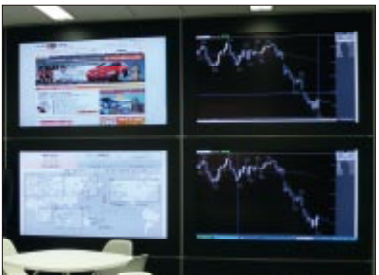
Large-screen TVs
Delivers high-contrast pictures even in a bright living room.



Public information displays
Distribute important and appealing information and images with greater visibility in open spaces.



Electronic posters/advertisements
A new advertisement medium that "shows information" with greater appeal and effectiveness.



Information walls
Various types of information can be displayed in real time and batch controlled.



LCD TVs



LCD monitors



Notebook PCs



Information Displays



(Simulated image)

"3D LCD" technology lets you toggle between a flat (2D) image and a 3D image at the touch of a button. On a PC with this technology, you could view text documents and spreadsheets in 2D and then switch to 3D mode for incredibly realistic computer graphics and games. The 3D LCD technology opens up new horizons in equipment use and enjoyment.

3D graphics with no special goggles

In the past it has been necessary to wear special goggles in order to view 3D graphics. The 3D LCD, however, uses a parallax barrier system implemented using a specially developed switching liquid crystal to deliver three-dimensional images that can be viewed without special goggles.

Simple panel structure for easy control

The ease of controlling the display makes it possible to use 3D LCDs for a wide range of applications. Its simple structure helps lower costs and provides excellent reliability.

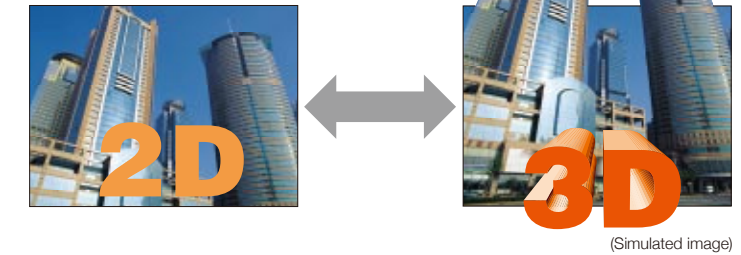
Operating principle of 3D LCDs

The distance between human eyes is about 65 mm, and the images seen by the right and left eyes are always slightly different (binocular parallax). The human brain processes the slightly different images from the two eyes to create a sense of depth.

- The directions in which light leaves the display are controlled so that the left and right eyes see different images. This makes it possible for the image on the screen to appear in three dimensions without the user having to wear special goggles.
- The basic principle of the parallax barrier system used has been understood for some time. It is achieved using a structure incorporating a conventional TFT-LCD and a specially developed "switching liquid crystal."
- The switching liquid crystal is used to implement the parallax barrier and control the directions in which light leaves the display. This ensures that different patterns of light reach the left and right eyes of the viewer.
- The images for both the left and right eyes are displayed together on the TFT-LCD, resulting in a 3D display in which the appropriate images reach each of the viewers eyes.
- The parallax barrier is controlled electrically using the switching liquid crystal. When light is allowed to pass through freely, the separation between the left and right eye images disappears, allowing 2D content to be perceived identically by the left and right eyes. In this mode the display panel functions in the same manner as a conventional LCD.

Switchable between 2D and 3D display modes

The switching liquid crystal enables the parallax barrier to be controlled electrically. Switching between the flat (2D) and three-dimensional (3D) display modes can be accomplished at the touch of a button. This means the most appropriate display mode can be selected to match the application.

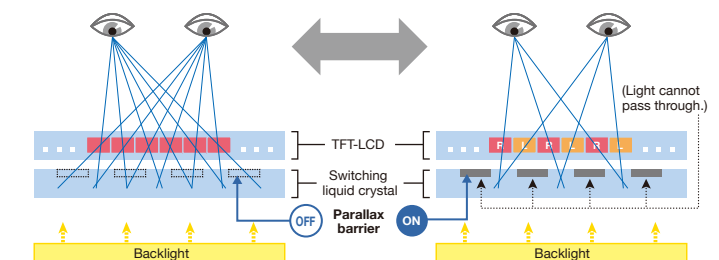


2D display mode

The switching liquid crystal is controlled so as to make the parallax barrier transparent, allowing all the light to pass through. This causes the same image to be seen by the right and left eyes, resulting in a two-dimensional display.

3D display mode

A parallax barrier is created by controlling the switching liquid crystal, thereby separating the light into two images. This causes different images to be seen by the right and left eyes, creating a sense of depth.



Applications

Realistic 3D images give content greater impact and range.



Museums

Illustrates historical or scientific reference materials in an easy-to-understand and visually impressive manner.



Arcade games

Powerful 3D images help to increase the impact and excitement of games.



Mobile phones



Handheld game consoles



Notebook PCs



Amusement equipment



Public displays

Sharp Dual Directional Viewing®

Liquid Crystal Display

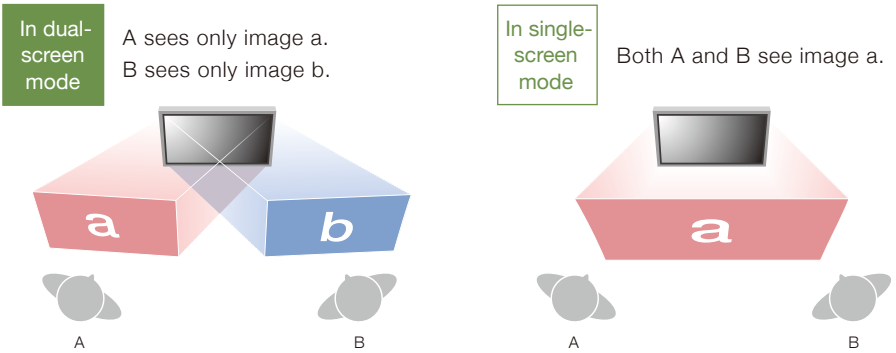
Displaying two different sets of information on one screen simultaneously.



The "Dual Directional Viewing®" LCD splits light left and right, enabling it to show two different sets of content on the same screen. This ability to display content such as TV broadcasts and Internet sites concurrently opens the way to myriad new uses, making Dual Directional Viewing® LCDs the ideal technology to cope with today's rapidly growing demand for greater access to information and other content.

Beautiful simultaneous display allows one panel to show two different screens

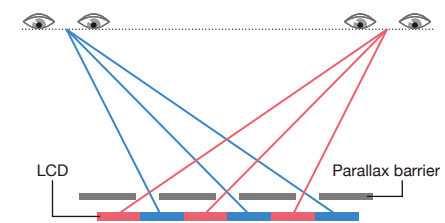
The Sharp Dual Directional Viewing® LCD panel displays different information depending on whether it is viewed from the left or from the right. The panel simultaneously displays two crystal-clear, high-quality images with no intermingling. Moreover, by displaying the same image on both sides, it can also function as a normal display, allowing everyone to view the same image.



How the Sharp Dual Directional Viewing® LCD works

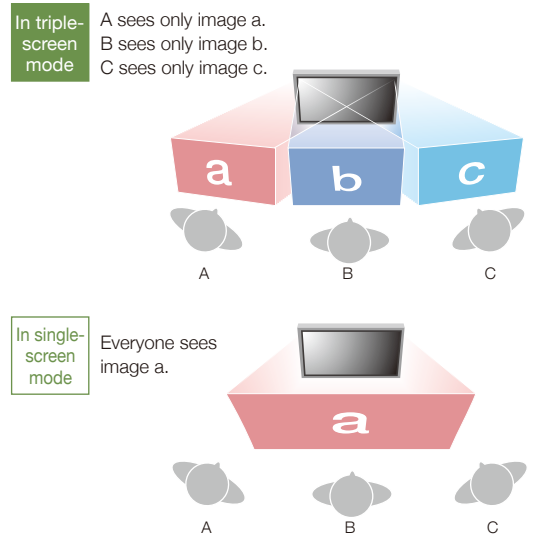
This technology evolved from Sharp's 3D LCD panels and is the result of advances in optical design technology and process technology (see p. 10)

A parallax barrier is used to divide light from the backlight into left and right components. Advanced optical design technology and process technology prevent intermingling of the left and right light components.



Sharp Triple Directional Viewing LCD (Under development)

The Sharp Triple Directional Viewing LCD takes this controlled viewing-angle technology a step further. Using a proprietary parallax barrier on a standard TFT LCD, the screen splits light in three directions—left, right, and center—and displays three separate images on the same screen at the same time. Sharp is meeting consumer needs by expanding its lineup and developing new and convenient uses for controlled viewing-angle LCDs.



Applications Concurrent display of information tailored to viewers on each side, in the same place, at the same time.



Business presentations

Check out the sales manual while you show customers the product specifications.



Vehicles

Creates the perfect driving environment by displaying car navigation screens to the driver and a DVD movie to the passenger.



Stores

Display information on new arrivals or sales campaigns that target different parts of the store.



Shopping malls

Display advertisements, store information, area maps or other content that is tailored to where viewers are heading.



Mobile phones



Games



In-Vehicle equipment



Public displays

Switchable Viewing-Angle®

Liquid Crystal Display

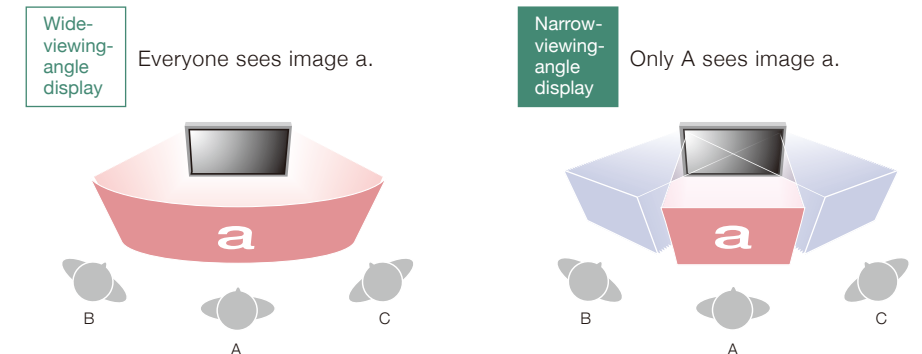
A "peek-proof" narrow-angle display to keep your information safe and secure.



Increasingly these days, people are using mobile equipment such as mobile phones, notebook PCs and PDAs to handle confidential information. Sharp's "switchable viewing-angle® LCD" technology lets you switch your screen's display mode from the normal wide viewing angle to a narrow angle, guarding against unwanted peeking by people nearby and helping prevent the leakage of confidential information.

A peek-proof LCD screen displaying images that are virtually unviewable from the side

Normally, the switchable viewing-angle® LCD screen has the same wide viewing angle as ordinary LCD panels. But a flick of a switch converts it to a narrow viewing angle that prevents unwanted viewing from either side.

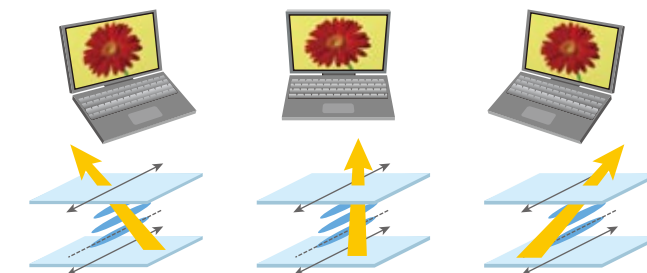


How the switchable viewing-angle® LCD works

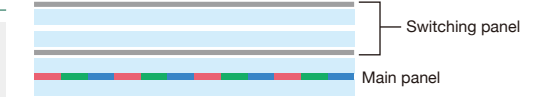
Sharp's switching liquid crystal is used to control light from the backlight.

Viewing angle control
OFF

The screen allows light to pass both to the front and to either side. This gives the display the normal optical characteristics for wide-angle viewing.

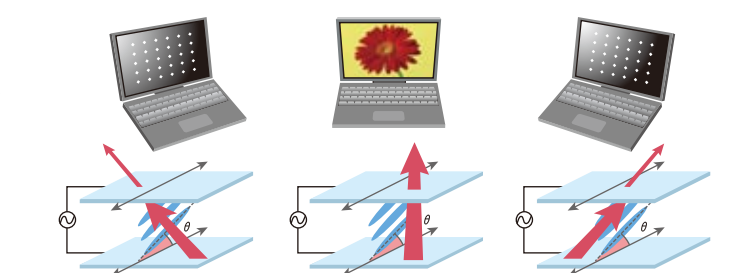


Cross-section view



Viewing angle control
ON

Voltage applied to the switching liquid crystal changes its directional characteristics, greatly reducing the passage of light to left and right. The result is an image on the screen that is no longer readily visible from either side.



Applications Enhances privacy protection, providing peace of mind as you use the device.



Bank ATMs

Protects customer privacy and boosts your corporate image.



While traveling

Lets you work on your PC in privacy while traveling on a train or plane.



Mobile phones



PDAs



ATMs



Notebook PCs

Memory Liquid Crystal

Liquid Crystal Display

Requiring no power except when ideal for applications where the

changing the display content, this new LCD is information remains constant, such as price tags.



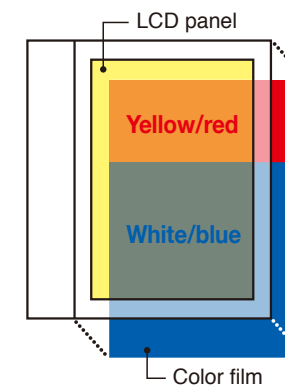
This LCD utilizes memory display elements that require no power except when changing the display content. It is ideal for price tags in supermarkets, where the information displayed does not change for a period of time. Linking the memory LCDs to a POS system through a wireless connection then makes it possible to quickly and easily update displayed prices. As well as reducing labor, time and costs, this system significantly reduces paper waste. Because the LCD panels store the displayed information internally, they use no power until the information is changed.

No power required, except when changing the display content, for low power consumption

The use of memory display elements eliminates the need for power except when changing the display content, thus achieving an environmentally friendly liquid crystal display.

Area colors

Color tones can be changed by using different colors for sections of the color film on the back of the LCD. This technique enables the creation of "area colors" in the LCD panel.



Easy-to-read wide viewing angle

The wide 135° viewing angle expands the range of possible applications.

Clear display with no secondary images (shadows)

This LCD requires no reflective plate and therefore characters and other images do not cast a shadow, resulting in a clearer display.

Many color variations

Various colors can be achieved through combination with a background color. You can also switch the display color of characters and images, as well as the background color.

Color variations (background)



Red/yellow



Black/green



Blue/white

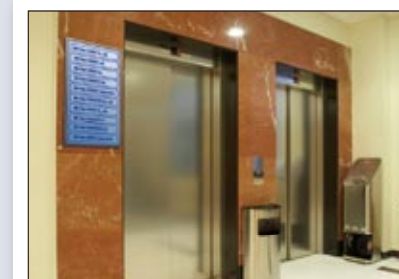
Applications

New possibilities for LCDs: Replacing paper



Electronic shelf price tags

In addition to eliminating the need for replacing price tags, the volume of paper trash can be greatly reduced.



Floor directories

Greater visibility. An energy-saving design that only consumes power when the display is being rewritten.

Strong

Liquid Crystal Display

Resistant to shocks, vibrations and high temperatures.
Ideal for on-site applications in the manufacturing and distribution industries.



Sharp's Strong LCDs were developed around a range of new technologies, including innovative mounting and drive technologies, liquid crystals capable of withstanding a wide range of temperatures, and backlights with an extended service life. Strong LCDs have excellent resistance to physical impacts, vibrations and variations in temperature, making them tough and highly reliable tools in the punishing environments routinely found in the manufacturing and distribution industries.

Simplified design for better reliability

The total number of component parts has been reduced considerably through consolidation and integration, allowing for the use of smaller circuit boards. This provides excellent performance, together with improved reliability.

Innovations in liquid crystal for better resistance to temperature extremes

The use of a specially developed new liquid crystal and optimization of the drive voltage results in the capability to function at a wide range of temperatures. This means that the Strong LCD can stand up even to punishing outdoor use.

	Conventional LCD	Strong LCD1	Strong LCD2
Operating temperature range	0 to +50 °C	-10 to +65 °C	-30 to +80 °C
Storage temperature range	-25 to +60 °C	-30 to +70 °C	-30 to +80 °C

Key technology used in Strong LCDs

High-reliability device mounting technology

The module was developed with high reliability in mind and the number of component parts has been kept to a minimum.

Temperature-resistant liquid crystal

Response is superior to conventional LCDs over a wide range of temperatures, allowing for outdoor use under punishing conditions.

Excellent reliability in spite of shocks and vibrations

Sharp has developed a module offering substantially better resistance to shocks and vibrations than conventional LCDs by reconfiguring the mechanical design and the usage of component parts. The ability to withstand surface pressure has also been improved, in order to allow the displays to be used as touch panels.

	Strong LCD1	Strong LCD2
Vibration resistance	57 to 500 Hz Acceleration 1 G	57 to 500 Hz Acceleration 1.5 to 2 G
Shock resistance	50 G 11 ms	60 to 70 G 11 ms

Module designed for stable results over long-term operation

The module provides stable brightness over a long period of time, thanks to the development of new technology for the backlight system. This enables it to operate satisfactorily for many years.

Applications Designed to be tough for stable operation even in harsh environments.



Industrial machines

Resistance to vibration

Withstands severe vibration while the machines are running, providing a consistent and clear display.



ATM

Resistance to pressure

Designed to be tough enough to withstand the strong pressure expected of touch-panel screens.



Monitoring
and control
systems



Outdoor
electronic
displays
Extreme
temperature
ranges



Panel
computers



Pressure
testing
equipment
Resistance
to impact



Gas station
POS
terminals

SHARP CORPORATION

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■ Specifications are subject to change without notice.
■ All screen images are simulated.

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The following facilities of Sharp Corporation have been certified under the ISO 14001 international standard for environmental management systems. In our products and manufacturing processes, we are actively engaged in environmental preservation efforts.

Facility	Certificate No.	Registration Date
Headquarters and Associated Companies Group	EC97J1037	June 24, 1997
Katsuragi Works	EC99J2006	June 25, 1996
Large-Scale IC Group*1 (Fukuyama)	EC99J2016	September 24, 1996
Nara Plant	EC99J2021	September 24, 1996
Advanced Development and Planning Center	EC99J2038	December 3, 1996
Mie Factory	EC99J2051	January 28, 1997
Kameyama Plant	EC04J0284	October 12, 2004
Communication Systems Group Hiroshima Plant	JQA-EM5312	April 14, 2006
Appliance Systems Group*2	JQA-EM5554	November 10, 2006
Audio-Visual Systems Group Tochigi Plant	JQA-EM0339	February 26, 1999

*1 The Group name has been changed to Electronic Components and Devices Group since April 1st, 2008.
*2 The Group name has been changed to Health and Environment Systems Group since April 1st, 2008.



The following groups of Sharp Corporation have been certified under the ISO 9001:2000 international standard for quality management systems.

Group	Certificate No.
Mobile Liquid Crystal Display Group	JQA-QM3776
AVC Liquid Crystal Display Group	JQA-QMA11778
Large-Scale IC Group*	JQA-QM8688

* The Group name has been changed to Electronic Components and Devices Group since April 1st, 2008.



The following division of Sharp Corporation has been certified as a manufacturer under the IEC Quality Assessment System for Electronic Components.

Applicable standards: ISO 9001:2000 and JIS Q 9001:2000
Certifying organization: Reliability Center for Electronic Components of Japan (RCJ)

Division	Certificate No.
Opto-Analog Devices Division	RCJ-94M-23K



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SHARP CORPORATION
A7887 ISO 9001:2000

Certifying organization: UL, Inc. [JAB, ANAB certified]

Division	Certificate No.
Compound Semiconductor Systems Division	A7887

NOTICE

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